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ABSTRACT

This booklet gives a list of general principles and suggestions for meeting the problems arising from requests from developing countries for assistance in improving their programs of mathematics education at all levels. Topics covered are major components for collaboration; conferences, seminars, and courses; consultants and short-time visitors; writing groups; training of indigenous mathematicians; evaluation; and pitfalls to be avoided. (DT)

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Conference Board of the Mathematical Sciences
Committee on International Cooperation in Mathematical Education

GENERAL PRINCIPLES OF INTERNATIONAL COLLABORATION IN MATHEMATICAL EDUCATION

by

Burton W. Jones

Produced with the support of the National Science Foundation and the Agency for International Development

SE 014 977

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PREFACE

The Conference Board's Committee on International Cooperation in Mathematical Education was formed in 1967, primarily to address problems arising out of requests from developing countries for assistance in improving their programs of mathematical education at both the college and school levels. The Committee's activities are funded through the Office of International Programs of the National Science Foundation and by the Technical Assistance Bureau of the Agency for International Development (AID).

To date the major task of the Committee, now completed, has been to evaluate the curriculum materials of the Africa Mathematics Program produced by summer writing teams in Africa under the auspices of Education Development Center, Newton, Massachusetts, with AID support. The evaluation involved assessment of the textbook materials by consultants, some of them European, as well as tests conducted in Ghana and Tanzania and field observations made in those countries and in Ethiopia, Kenya and Uganda. An extensive report on the evaluation was prepared and submitted by the Committee to NSF and AID in the fall of 1969, and this was supplemented by a further report on the test results in the spring of 1970.

From the outset of the Committee's activities, NSF and AID have emphasized their interest in a distillation of the "transfer value" of the work of the Committee, that is, a formulation of general principles, based on the experience of the Committee, its members and its consultants, that would clearly be of value to U.S. workers in any discipline in any developing region of the world.

The Committee is fortunate in having as one of its members Professor Burton W. Jones of the University of Colorado, who himself has had extensive experience with projects in Latin America designed to improve mathematics education at both the collegiate and school levels. Drawing on his own experience, as well as that of other members and consultants of the Committee, Professor Jones has produced the present compendium of general principles of international collaboration in mathematics education. Of particular value have been the comments of Professor Robert Dilworth of the California Institute of Technology, who was intimately involved with the Africa Mathematics Program, especially in its testing and evaluation aspects. Several other members of the Committee have had experience with overseas projects in mathematics education, and all have contributed by reading and commenting on this compendium in its earlier drafts.

December, 1970

George Springer
Chairman
CBMS Committee on International
Cooperation in Mathematical Education

GENERAL PRINCIPLES OF INTERNATIONAL COLLABORATION

IN MATHEMATICS EDUCATION

Though these principles are stated against a background of mathematics education in Latin America and writing groups in Africa, it is certainly true that most are applicable to other regions and disciplines. Though all may seem obvious, they have been disregarded often enough to make them worth stating. Almost every point can be made also for programs in the United States. Some of the same problems and principles are considered in "Teacher Education and AID", a study prepared by Louis W. Normington, published by the American Association of Colleges for Teacher Education, Washington, D.C., 1970.

A. Major Components for Collaboration

1. One should use every means at his command to find out whether the project in question is really something which the local group want and need. The best evidence is *a priori* commitment of local money and personnel. One should try, difficult as it is, to ascertain the motives in a request: do they arise chiefly from rivalry with other departments, other institutions and other nations or are they based on a definite long-term need. For example, does the institution want to set up a master's degree program in mathematics to establish its superiority over other institutions and/or for its increased prestige in the eyes of the University and government; or does it have a genuine interest in the better training of its staff so that university and secondary school teaching may be improved? Does it at present have some staff who are capable and committed to such a program and have they already begun it on their own? If a computer is asked for, what is its expected use? Of course a granting agency has the right and duty to decide what projects it will support.

2. One should work within existing viable institutions wherever and whenever possible. Unstable though governments, ministries and universities may be, the chances are that they are much more secure than any new institution set up with outside help. No program can succeed without the approval and active support of those in charge. For projects in education this means that one of the first approaches must be to the minister of education and the appropriate local institution(s) of higher learning. Rivalry can be disastrous. There are also political implications (see section G).

3. Participants from the United States should be carefully selected not only for professional competence but for personal qualities of patience, tact, warmth, humility, openmindedness and quick appreciation of the pride (and sometimes insecurity) of others. As Charles H. Malik put it,* one's effectiveness depends on "how much one stands firm on the good in himself; how much one appreciates the good in others; and how much one has the humility, the grace, and the self-confidence to enter into creative intercourse with others on the basis of the good in them and the good in himself."

4. One must work within existing cultures. However badly, from our point of view, certain aspects need to be changed, this will not come about until they see the need for it; even after that, it will take a long time. They should be helped to identify their problems before solutions are attempted. A project should be part of an overall program for economic and social development.

For example, it is the tradition in most Latin American universities to admit most students who apply and set the level of courses too high, with the result that a large majority of the students expect to and do fail. In Guatamala

*"The World Looks at the American Program" Education and Training in the Developing Countries: the Role of U.S. Foreign Aid. (Edited by William Y. Elliott) New York: Praeger, 1966, p. 40.

when the general studies program was instituted to concentrate the mathematics in one department instead of having it taught in each of several faculties, it swung too far, in that all students whether in law or engineering took the same introductory mathematics course. For a while it seemed to be moving toward multiple courses since much of the university community was aware of other advantages of a unified program. Now the pendulum has swung back and the general studies program has been abolished. On the other hand at the University of Costa Rica it seems to be working very well. There are also political implications here (see below).

5. Of primary importance is agreement and clear understanding of aims on the part of all those involved. (See section D.2).

6. A project should seek to develop in any country the capacity to solve its own problems. Part of this is to help set a climate for orderly change.

7. Visitors must have as much prior knowledge as possible about the country and situation which they will face. Even those who have had much prior experience could profit from specific orientation. Sometimes information about a country is available in Washington (e.g., in the Smithsonian Institution) which is hard to find in the country itself.

B. Conferences, Seminars and Courses

1. In planning a course or seminar, one should do one's best to try to set a level of preparation and sphere of interest. At least in the beginning one must usually set the level lower than advance information indicates. One should aim to determine the local tradition with regard to studying outside of the university. For instance, in Latin America the tradition seems to be largely to concentrate studying in "practicas"--two hours of supervised study in small sections for each lecture period.

2. If the students are teachers it is difficult to get response to homework or to give examinations and grades One device which has been used is to ask only those wanting credit to take examinations; thus no one failed but some did not receive credit. Also papers can be corrected without giving grades.

3. One should bend every effort to have useful books available at a price the students or teachers can afford. Getting the right books in the right place at the right time is very difficult but it can be done. In Bogota, in the summer of 1967, the Fulbright lecturers were impressed to find copies of the Spanish translation of Birkhoff and MacLane's "Modern Algebra" at hand for all the participants at the beginning of a short course at the Instituto de Ciencias; no doubt because of the energy, resources and contacts of the director. This is not unique but it is rare. Not only is it important to find what books are in the library but how accessible they are to the students. Sometimes library books are kept in locked cases; sometimes they are only in the offices of the professors.

There is also the tendency to use hastily developed notes instead of a book, partly as a result of the urge of the institution and the lecturer to publish. This practice should be avoided whenever possible. There are various agencies which can assist in inexpensive publication: USIS, ARTAC in Mexico for Latin America, PL 480 programs in local currency, Franklin Book Programs (801 Second Avenue, New York City 10017). Publishers on the home ground, such as Norma in Colombia, are sometimes interested. In fact, the mathematics literature in Spanish is quite extensive.

4. Short conferences or seminars should, whenever possible, be located in a place apart from the participants' home ground. "Moonlighting" is common and even those who are barred from this have heavy loads. To get a man's undivided

attention one must tear him loose from his local environment. For instance, a physics conference in Antigua, Guatamala, was successful partly because of its location apart. These remarks, however, do not apply to courses of longer duration which are a part of the university structure.

5. If the course is to be given by someone outside the institution, it should be planned in collaboration with at least one local person, in addition to the one who is to give the course. Having a young assistant from the country can be very helpful.

C. Consultants and Short-time Visitors

1. Short-time visitors can be useful for collecting and dispensing information if they can be put in touch with those who know and will tell. There must be careful preparation for such visitors by those on the local scene. Most important, of course, are names of whom to see and the means of seeing them. But it is very difficult to penetrate the barrier of a foreign culture, and usually the short-time visitor is not very effective. In fact there are occasions when he can be a detriment to an on-going program.

2. Not much planning can be done by correspondence. There must be a local person on hand--preferably a citizen of the country--to guide the planning. The effectiveness of the specialists in a Central American program was immeasurably increased by the presence of a local coordinator who could make plans and contacts for the specialist on his way down and for his activity while there.

3. The timing of the visit is important. For instance, in one instance, a visit was arranged at the beginning of a term because it fitted into the consultant's schedule. It was a tribute to Latin American hospitality that he was cordially received.

4. A consultant can be useful if he conceives his role to be that of one asking questions which the local persons should answer. Even within this framework it is very difficult for such a consultant to be effective. His reputation can precede him but time is necessary to establish confidence in him as a person. This cannot be rushed. Really he should be part of the working staff of an institution for at least a year before he can give any advice which is worthwhile or will be listened to.

The consultant can be most useful in helping the local persons formulate objectives, set up priorities and determine means of arriving at ends. For example, some questions might be: Why is mathematics important for your country and what kind of mathematics? If instruction in the schools needs to be improved, where should we start and what can we hope to do in the beginning? Is "pure" mathematics a luxury which a developing country cannot afford? To what extent should stress be laid on mathematics which contributes directly to technology? What examples from other countries would apply here and what would not? At various stages in the education process are we giving most students what mathematics they really need or are we neglecting all but those few going on to universities? What traditional patterns must be changed if progress is to be made and how can one start? Many of these questions need to be raised in one-to-one talks with an influential, experienced and wise local person, based on mutual confidence and esteem.

The consultant must constantly keep reminding himself that the object of collaboration is not to extend the influence of the United States but to help the country set up and attain its own goals. He should never forget that he is an outsider.

5. Without follow-up, most is lost. As is true everywhere, men will work with concentration at a short conference and draw up great plans and many fine

resolutions (spending much time on exact wording), but back on the home ground, burdened with daily tasks, they can soon forget the fine words. A calendar of hoped-for-progress can be useful. A planned later visit can serve as a deadline for accomplishment and reassessment. Correspondence can be hoped for. Means of publicizing progress can be helpful.

D. Writing Groups

1. Of prime importance is local involvement at every level and every stage. The first approach should be through the minister of education. Then one of the most difficult problems is the selection of local participants. The local ministry is often tempted to select persons for political or personal reasons rather than competence and suitability. On the other hand, the consultant must realize that not only competence but knowing and having the confidence of key people is important. Weighing these factors and helping the local ministry to choose the most effective persons is a very delicate matter. These remarks also apply to those selected to leave their country for meetings or training sessions.

Effective outside help can be in the form of supplying sources and samples of other writing and types of teaching methods which have been found useful elsewhere. Help can be given in acquiring background in the philosophy of curriculum development. Often this can be done by the consultant in the course of his cooperative endeavor with local persons.

Outside consultants are not directors. They must consider themselves and act as consultants rather than initiators or controllers. A conscious and vigorous effort must be made to get the local persons to assume leadership from the beginning. The outsider must respect their judgment even when he does not agree. In the end, the decisions are theirs.

2. The aims of the writing project must be clearly understood in the beginning and not forgotten. (See A.5) Is the object to produce a new curriculum or to

give the local persons training in curriculum development? That is, is the plan to be that the consultants work with local persons to develop text materials or that the consultants give the local persons training in devising a new curriculum and writing text materials for it? For each of these questions, the answer would seem to be "the latter", though it may well be that the best way to train local persons is to develop some materials cooperatively. The involvement of the visitor depends on the extent of sample materials available and the experience of those with whom he is working.

3. To insure use of written materials concomitant activities are necessary. The written materials will have little impact unless other activities are initiated simultaneously: teacher training, training those who train teachers, reform of the examination system if any, printing and distribution, provision for trying out, evaluation and revision. If the texts are in English--not the native language--local persons who are familiar with the problem of teaching English as a second language should be involved, so that the language in the writing may be modified accordingly.

Those involved in the writing should visit schools to become acquainted with teachers and administrators at the local level not only to involve them in the project from the beginning but to observe classroom styles, pupil reaction, types of facilities, etc. There must also be some missionary effort to show the local teachers the reasons for the proposed changes and their fundamental nature.

4. Working site. It must provide enough comfort and diversion to satisfy the participants from abroad but must not be so elegant and expensive as to make local participants feel uncomfortable or have ulterior motives for participating. It must provide ample facilities for individual work, group conferences, library space and recreational facilities. It must be accessible and some local schools must be accessible from it.

5. Continuity in local and visiting personnel is very important. This is often difficult to achieve but its importance is obvious. As much as possible, the local persons as well as the outsiders should be full-time with a project.

E. Training of Indigenous Mathematicians

1. Wherever possible a degree program is best. The advantages are many: One has a planned course of study with a definite standard to be maintained, those participating are more apt to submit to evaluation of one kind or another and they will strive much harder to master the material. Such a program is much more effective than separate courses, which may arouse interest but whose lasting effect is questionable. In many developing countries a master's degree sets one apart.

Sometimes master's degree programs are started with courses given by outsiders. If such persons are from outside the country there are apt to be difficulties because of short-term appointments and lack of planning. If the national university of the country has a master's degree program, some kind of exchange would seem to have a good chance of success. In case there is no master's degree program in the country it will probably be necessary to send some members of the staff outside the country (not necessarily to the United States). Probably in any case the local institution would need help in planning a program. By whatever the means, the aim is toward a "critical mass" where an interplay of ideas among those who are well-trained can start a "chain reaction" from which a permanent local program can be born.

2. As much as possible of the training should be done within the country. When a person is away from his country for a long period of time there are many problems which may arise. He may lose contact with influential persons in his country and with ongoing events in his own institution. He may become accustomed to another way of life and even lose some sympathetic contact with his fellow

nationals. He should be warned of these dangers so that he may avoid them and be encouraged and assisted in his efforts to maintain contact. On his return, provision should be made for orientation. On its part, his home institution, not being able to pay an expatriate what it can a foreigner, may have difficulty in finding an appropriate niche for him on his return. This should be avoided by advance planning and commitment on its part,so that when he returns an appropriate post may be waiting for him. Certainly there is a dual obligation: on the student, to return for at least a period of time and on his institution to employ him so as to profit from his experience. To be sure, there are examples of expatriates dividing their time between a post in their own country and their adopted one, but these are rare and beset with many pitfalls.

3. "Bettering" local conditions of the faculty where it is concerned with salaries, teaching load, size of classes and the like, really must be done largely by the university and country itself, unless the collaborating agency is willing to give massive financial support over a long period of time.

F. Evaluation

When funds are limited, there is a strong tendency to cut back on evaluation activity. This is false economy. It will be most effective when such evaluation is built in from the start of a program. It should go on during a project so that, where indicated, change of direction and emphasis is possible. Evaluation after a phase is completed can indicate not only what the next steps should be but may save money and effort in setting up new programs. At least one of the consultants should be an expert in testing and there should be training of local persons in such techniques.

G. Avoidance of Certain Pitfalls

1. Flexibility is of prime importance. This means that, while careful planning is wise, not all contingencies can be foreseen and one must continually improvise and adapt. Since no program can be expected to work out as planned, there must be someone on the ground with the responsibility to keep track of how things are going and with power to change direction when this is called for. One must remember that it is not the program which is important but what it does.

2. The political scene must be reckoned with. Those who do not want change can combine with those who shout "Yankee Imperialism" to wreck any program. This is one reason why it is so important that any project be theirs and not ours, and that it be part of an institution of their own. It is in such times where the temper of the steel of their own involvement and dedication is given its test. An outside consultant must exercise special care not to become involved in local contests or be used by one group against another.

3. Collaboration amongst nations is very difficult to achieve. This seems to work (in whatever the sphere) only when each nation involved believes that such cooperation is helpful to its own interests. There was in Central America an association of the National Universities, the Consejo Superior Universitario Centro-americano, which was initiated with outside help and functioned for a time. The Inter-American conferences in Mathematics Education of 1961 and 1966 were most enthusiastically participated in. Their chief function was to inform representatives of each country about what is going on elsewhere, to make contact among leaders in respective countries and to lay groundwork for international cooperation. While progress has been slow, there are increasing contacts. For example, the National University in Colombia has has visitors from Argentina and Brazil and there is some prospect of an exchange program in mathematics

between it and the University of Buenos Aires. There was a meeting in Equador of mathematicians of Colombia, Venezuela and Peru, with a visitor or two from Mexico.

Though multi-country programs are very difficult to achieve, one should try them wherever possible, since it is not only more economical and efficient but can help to bring about friendly relations among neighbors. If this is done, a core curriculum and basic writing training should be the aim. The actual materials probably would have to be developed within each country and by its citizens.

4. Before priming the pump one should be sure there is water in the well and local power to keep the water running once it is started.

5. A project always takes more time than one expects. The ROCAP project in mathematics turned out to be a long-term program. The Central American program needed more time. It took the Ministry of Agriculture of Mexico, with the help of the Rockefeller Foundation, 17 years to turn Mexico from an agricultural importer to an agricultural exporting nation; looking back on it, one realizes that this was a very short space of time in which to accomplish so much. There are many factors in the time-consuming process; changes of personnel in the host country and the United States, time required to build up confidence and teamwork. Also one can seldom start in the right direction--he must find the channel through which affairs can flow and continually dredge out the obstacles brought down by the rush of the current or which come to light as the channel deepens. Quite often it is the person from outside who has to urge patience and the wisdom of not trying to do too much in too short a time.

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